SCIENCE

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*THE ADVANCEMENT OF MEDICINE BY RESEARCH.**

MR. PRESIDENT AND FELLOWS OF THE MASSACHUSETTS MEDICAL SOCIETY:

The recent attempt by the Society for the Prevention of Cruelty to Animals to secure legislation for the restriction of biological research in Massachusetts, and the probability that the attempt will be repeated during the next session of the Legislature, may serve as my excuse for asking you to consider the history and significance of the movement, the inevitable result of its success, as well as the moral principles which here find their application.

That the Legislature of Massachusetts should be requested to restrict the right of physicians to study their profession, and of the higher educational institutions of the State to teach the sciences on which the practice of medicine rests, is a phenomenon which surprises no one who has watched the progress of the so-called 'anti-vivisection' agitation during the last quarter of a century. At various times within this period have the efforts of misguided benevolence been directed to checking the progress of medical science by interfering with one of the most important methods by which advances can be made. Fortunately for humanity, these efforts have, in nearly all

* The annual discourse, delivered June 10, 1896, by the President before the Massachusetts Medical Society.

cases, been rendered futile by the sound common sense of the community. In England alone, of all civilized countries, has a certain amount of success crowned the efforts of fanatical agitators and, by the enactment of a restrictive law, a serious blow has been inflicted upon English physiology.

In the presence of such an agitation it is, of course, to the members of the medical profession that the community, distressed by the constant repetition of tales of imaginary atrocities, will naturally turn for the assurance that teachers of the medical sciences are not brutes and criminals, and that medical students are not young ruffians who delight in blood and suffering. It is, therefore, important that physicians should be at all times ready to explain to the laity how, as Dr. J. G. Curtis has happily expressed it, 'in the slowly woven fabric of achievement pure science and applied science, biology and medicine, have always been warp and woof.'

It requires no professional training to comprehend that a knowledge of the bodily functions in their normal state is essential for the understanding and treatment of those derangements of function which constitute disease, and that physiology, which deals with these normal functions, must, therefore, form the basis upon which medical science and medical practice alike must rest. Now nearly all the phenomena of life which form the subject matter of physiology are either physical or chemical in their character. In fact physiology must be regarded as the physics and chemistry of living bodies. Therefore, just as the physicist and the chemist build upon the basis of experiment the solid superstructure of their sciences, so the physiologist can hope to advance firmly and successfully to the discovery of the laws of life only on the condition that the same experimental method supplies the stepping stones for his progress.

Self-evident as this proposition seems to the student of nature's laws, certain persons are ready to deny the legitimacy of the experimental method of research when applied to living bodies, while they admit it to be absolutely indispensable in the case of non-living matter. The cause of this attitude of mind is not difficult to discover. In fact, it has its origin in the noblest feelings of human nature, in the sentiment that bids us be merciful as we would obtain mercy. Those who hold these views, profoundly impressed by what they conceive to be the painful nature of experiments performed on living animals, and by the alleged indifference to animal suffering shown by the experimenters, have not hesitated to bring charges of cruelty against those who are engaged in seeking to penetrate the mystery which still surrounds the actions and reactions of living organisms, and thus to lay, broad and deep, the foundations on which the medical science of the future is to be built up.

I have used the words 'misguided benevolence' in speaking of this agitation, and there is no doubt that many, though unfortunately not all, of the persons engaged in this crusade are benevolent in their disposition and conscientious in their attitude, but it should be remembered that, as Mr. Roosevelt recently remarked, "Conscience without common sense may lead to folly which is but the handmaiden of crime."

In judging of the moral and mental attitude of those who are engaged in this mischievous agitation it is important to distinguish carefully between the leaders and the followers. The former are fortunately very few in number, but by their activity and apparent ubiquity they easily create an impression of being in much larger force. Dominated by the single idea that vivisection is an 'abominable thing and hateful in the sight of God,' they presume to teach lessons of humanity to the members of a

profession which exists for the relief of suffering. Unable to comprehend the reports of biological investigations published for professional readers, they recklessly denounce perfectly painless experiments as cases of fiendish torture. Deliberate and authoritative statements setting forth the necessity of animal experimentation for the advancement of medical science, the vast amount of good already accomplished and the comparatively trifling amount of the suffering involved, are treated simply as falsehoods such as might naturally be expected from the 'cowardly criminals' who practice vivisection.

This movement is, therefore, by no means to be regarded as a simple humanitarian effort to reduce to a minimum the amount of animal suffering connected with vivisection. Restrictive laws like that of England are denounced as useless, and the total abolition of the practice is imperatively demanded. That this will have the effect of seriously checking the advance of medical science some of the leaders ignorantly deny, while others contemplate this result with satisfaction, for they deny the right of the human race to profit by animal suffering, and condemn the saving of a human life by the sacrifice of that of a dog. That this is not an exaggerated statement of the position assumed by anti-vivisectionists, a single quotation from the writings of Henry Bergh will suffice to show. Mr. Bergh was for many years President of the New York Society for the Prevention of Cruelty to Animals, and was throughout his life the acknowledged leader of the anti-vivisectionists in America. In a lecture on this subject delivered in 1880 occurs the following passage: "As another proof of the profane extremes to which these dissectors of living animals will go, Robert McDonald, M. D., on being questioned, declared that he had opened the veins of a *dying person*, remember, and had injected the blood of an animal into them, many times, and had met with brilliant success. In other words, this potentate had discovered the means of thwarting the decrees of Providence, where a person was dying, and snatching away, from its Maker, a soul which He had called away from earth!" It seems to me that this blasphemous denunciation of a physician for saving a human life needs absolutely no comment.

It might naturally be supposed that such extravagances of statement would carry their own refutation, and would demand no more attention from serious people than the utterances of those medical philosophers who deny the utility of vaccination. Acting upon this supposition, and unmindful of the fact that lies travel faster than truth, biological investigators have, as a rule, not thought it necessary to contradict specifically the various misstatements which have been published with regard to their work. The result has been that certain excellent people, of emotional dispositions, and without the special training which would enable them to judge correctly of such a question, have been led to believe that so much smoke must indicate some fire. They have, therefore, by joining anti-vivisection societies, lent the weight of their names and their purses to a movement fraught with danger to the welfare of the State. That members of our own profession have occasionally expressed themselves in such a way as to encourage this agitation is to be deplored, but not wondered at, for no one listens more sympathetically to a tale of suffering than a true tender-hearted physician; and if he does not happen to be in a position to contradict from his own knowledge the heart-rending stories which are poured into his ears, he may be readily convinced of the existence of abuses requiring legislative interference.

Recognizing the true nature of the anti-vivisection agitation, it is evident that edu-

cated physicians would be false to their high calling did they not resist with all their energy the attacks of an enemy whose success would destroy all hope of establishing medicine in the position to which it is rightfully entitled, that of the most important branch of biological science.

In thus maintaining their right to study and teach their profession, physicians are not called upon to maintain that unnecessary pain has never in the history of the world been inflicted in connection with vivisection. Their true contention should be:

1. That the men in charge of the institutions where vivisections are practiced in this State are no less humane than those who desire to supervise their actions, while they are, at the same time, vastly better informed with regard to the importance of animal experimentation and the amount of suffering which it involves.

2. That no abuse of the right to vivisect has been shown to exist in these institutions.

3. That the governing bodies of these institutions possess both the will and the power to put a stop to such abuses should they arise.

4. That the existing statutes furnish sufficient protection against cruelty in vivisection as well as against cruelty in general.

5. That for the reasons above given legislation on this subject is wholly uncalled for.

These propositions define substantially the position assumed by this Society in the resolution adopted four years ago in response to a communication from the Massachusetts Society for the Prevention of Cruelty to Animals, and, with the medical profession united in their defence, no fear need be felt that our Legislature will ever yield to the pressure of fanatical agitation to the detriment of the best interests of the community.

A full account of the origin and progress of the anti-vivisection agitation would, of course, be impossible within the limits of this discourse, but it will be well to refer briefly to the history of the movement in other communities, calling attention to certain points which are full of instruction and warning for ourselves.

The first serious attack upon biological research in England seems to have been made in an essay entitled 'Vivisection, is it Necessary or Justifiable?' published in London in 1864 by George Fleming, a British army veterinary surgeon. This essay is an important one, for though characterized at the time by a reviewer in the London Atheneum as 'ignorant, fallacious, and altogether unworthy of acceptance,' its blood-curdling stories, applied to all sorts of institutions, have formed a large part of the stock in trade of subsequent anti-vivisection writers.

A fresh stimulus to the agitation was given by the publication, in 1871, of a work edited by Prof. J. Burdon Sanderson, entitled 'Handbook for the Physiological Laboratory.' This book was intended to be used by students of physiology under the guidance of their instructors, and contained a description of the experimental basis on which modern physiology rests. Unfortunately, however, it fell into the hands of excitable men and women, who were ignorant of many things which had properly been taken for granted in writing for members of the medical profession. That anæsthetics, for instance, would be used in all cases to which they are applicable, was tacitly assumed just as it would be in a work on operative surgery. In consequence of this failure to comprehend the object for which the book was written, many well meaning but too impulsive people jumped 'to the conclusion that raw medical students were being encouraged to repeat, for their pleasure, every experiment that had ever yielded results, careless

whether the subjects were conscious or unconscious of pain.' This misconception tended to produce an excited state of popular feeling which was intensified by the performance, at the meeting of the British Medical Society in 1874, of some experiments on dogs, showing the difference between alcohol and absinthe in their physiological action. The excitement culminated in the appointment of a Royal Commission to inquire into the subject. The result of the investigation was a report which cannot be better described than in the language of Lord Sherbrooke (better known as the Right Honorable Robert Lowe): "The commission entirely acquitted English physiologists of the charge of cruelty. They pronounced a well-merited eulogium on the humanity of the medical profession in England. They pointed out that medical students were extremly sensitive to the infliction of pain upon animals, and that the feeling of the public at large was penetrated by the same sentiment. * * * They then proceeded to consider to what restriction they should subject the humane and excellent persons in whose favor they had so decidedly reported. They acquitted the accused and sentenced them to be under the surveillance of the police for life." Remarkable as was this conclusion of the commission, the action of Parliament based upon it was still more extraordinary, for a law was enacted which, taken in connection with the previous legislation, has brought about a state of things in England which has been well described as one "in which it is penal to use domestic animals any way cruelly, but in which any one may torture wild creatures in whatever fashion he likes, *provided it is not for scientific purposes.*"

The amount of mischief which may be produced by this English law depends very much upon the good judgment of the Home Secretary, to whom its enforcement is entrusted. The most eminent members of the medical profession in England have at times been refused a license to perform experiments which they declared to be of the greatest importance for medical science, and, in general, it may be said that the system of licensing and government inspection under which biological research work must be conducted is, under the most favorable conditions, a source of serious annoyance to investigators, while it does not secure any better guarantee for the humane treatment of animals than is afforded by the character of the man engaged in the work.

The system, moreover, fails entirely to satisfy the anti-vivisectionists, who, in support of their demand for a prohibitory law, continually circulate the most exaggerated and perverted accounts of experiments performed in licensed and inspected laboratories.

The first outbreak of the anti-vivisection agitation in this country occurred in New York some fifteen or sixteen years ago, when the State Society for the Prevention of Cruelty to Animals, under the leadership of Henry Bergh, attempted to secure the passage of a law prohibiting the practice of vivisection. The agitation was conducted with so much fanaticism, and the method of garbled quotation employed by Mr. Bergh was exposed so effectively by the late Dr. J. C. Dalton, that the Legislature not only declined to enact any restrictive laws, but maintained in full force an amendment to the general law against cruelty to animals adopted in 1867, providing that "nothing in this act contained shall be construed to prohibit or interfere with any properly conducted scientific experiments or investigations, which experiments shall be performed only under the authority of the faculty of some regularly incorporated medical college or university of the State of New York."

New York has thus set an excellent example to her sister States in protecting her men of science, in their attempts to enlarge

the bounds of human knowledge, from the vexatious interference of persons who can know nothing of the importance of the work or of the amount of suffering which it involves.

In Pennsylvania, also, attempts to secure restrictive legislation have been made by the American Anti-vivisection Society, which has its headquarters in Philadelphia, but the energetic protests of the medical profession have sufficed to render these attempts abortive.

In Washington, during the present session of Congress, the efforts of the local humane societies have been so far successful that the Committee on the District of Columbia has brought before the Senate a bill providing for the licensing and restricting of vivisection, but there seems to be little reason to fear that such a bill will become a law.

In Massachusetts the State Society for the Prevention of Cruelty to Animals has, until quite recently, treated this question with moderation and good sense. While regretting the necessity for sacrificing animal life for the advancement of science, and anxious, like all right-minded people, to reduce the sufferings of such animals to a minimum, it has not seen in the existing state of things any reason for demanding additional legislation or for taking any action under laws already in force. A few years ago the President of the Society publicly called attention to the failure of the anti-vivisection agitation, both in this country and in Europe, to effect any reduction in the number of animals subjected to experiment, and maintained that the proper attitude of the Society should be one of co-operation with the best men of the medical profession in seeking to prevent any abuses from arising in connection with the practice of vivisection. To the friends of the Society who rejoice in the good work it has been able to accomplish in the community, it must be a matter for sincere regret that this wise policy has been abandoned, and that the Society now finds itself arrayed in opposition not only to the medical profession, but also to the higher educational institutions of the Commonwealth. It is, however, but just to state that this position seems to have been assumed without any formal action by the governing body of the Society.

The bill first presented by the Society to the Legislature of 1896 provided that no painful experiments upon living animals should be performed in any educational institution of the State, except under the authority of the State Board of Health, and that the Massachusetts Society for the Prevention of Cruelty to Animals might supervise all such experiments. Violations of the law were to be punished by fines which, when collected, were to be turned over to the Society.

During the hearings before the Judiciary Committee of the House this bill was twice modified, first by the omission of the section relating to the State Board of Health, and of the clause requiring the fines to be paid into the treasury of the Society, and subsequently by providing that the agents of the Society employed to supervise vivisections should be doctors of medicine. The petitioners for this legislation were, one after another, compelled to acknowledge under cross-examination, that they were unable to present any evidence of cruelty practiced in the educational institutions of Massachusetts in connection with vivisection, while the remonstrants, by a straightforward account of what actually occurs in physiological laboratories and by an exposure of exaggerations and misstatements with which anti-vivisectionist literature abounds, sought to convince the committee of the mischievous character of the agitation and of the unfortunate results which would necessarily follow the pro-

posed legislation. Shortly after the close of the hearings the committee presented a unanimous report recommending "that the petitioners have leave to withdraw."

Having thus called your attention to a few salient points in the history of the anti-vivisection movement and indicated the methods employed by the leaders of this crusade against the work of a profession whose glory is to save, let me next ask you to consider the reasons which not only justify students of medical science in resorting to experiments upon living animals, but require them to do so as a necessary condition of any important advance.

In dealing with this question I shall make free use of a work entitled 'Physiological Cruelty, or Fact *vs.* Fancy, by Philanthropos.' This book, which appeared in 1883, contains by far the most comprehensive, logical and dispassionate discussion of the subject with which I am acquainted.

The vivisection question reduced to its simplest expression may be stated as follows: "Have we a right to give pain to animals in order to study the phenomena of life?" In answering this question we perceive at once the necessity of a clear conception of what pain really is, and in striving to obtain this conception we are struck by the fact that pain is a purely subjective phenomenon. We *know* absolutely nothing about pain, except that which we have ourselves suffered. We infer, of course, when we hear another person describe a painful sensation, that his feelings are similar in a general way to those which we imagine we ourselves should experience under like circumstances. This assumption of similarity of sensation is justified by the facts of our common human nature; but we are often struck, when listening to such descriptions, by the apparent difference between the impressions produced upon different individuals by the same external cause. A trifling surgical operation, which will not be considered worth mentioning by one individual, will, to another, be apparently the source of most acute suffering. We are thus led to suspect that, even in the circle of our own acquaintances, there must be quite a wide range of sensibility to pain. If we extend our observation over a wider field, we find reason to believe that in the human race there is a certain rough proportionality between sensibility to pain and intellectual development. A case is recorded, for instance, of a Russian serf who, while splitting logs in a forest, was caught by the thumb in the crack of a large log from which the wedge had unexpectedly flown out. He tore himself free from his painful imprisonment, as a wild animal might have done, leaving the thumb in the log, with the long tendons of the forearm still attached to it. It is doubtful if a more civilized man could have subjected himself to this operation, even with the alternative before him of an indefinite imprisonment in the forest. The cruel tortures which savages inflict upon their friends and themselves, as in the initiation rites of the Mandan warriors, seem to be best explained on the supposition that their sensibility to pain is less acute than that of civilized races.

In the case of the lower animals the evidence of a low sensibility to pain is much more conclusive. Among our domestic animals the horse and dog are commonly regarded as standing nearest to man in intelligence and sensibility, and yet nearly everyone who has had much to do with these animals will recall instances of great indifference shown by them to what would be to us severe pain. A single illustration of this insensibility may suffice. A horse whose leg was badly broken was sentenced to be shot, but during the two hours which intervened between the sentence and the execution the animal limped about to graze, dragging the fractured limb dangling behind it in a way which would have

caused a human being exquisite agony. It is evident, therefore, that it is entirely impossible to draw conclusions with regard to the sensations of animals by an effort to imagine what our own would be under similar circumstances. Our common human nature, which serves as a guide, though an imperfect one, in estimating the sufferings of other human beings, fails us entirely when we have to do with animals, and we are left to draw conclusions from cries, motions and other external signs of suffering. Now these external signs are apt to be misleading, for they only prove "that something is going on which the organism repels," but do not prove that the animal is conscious of what is going on. In other words, the cries and struggles of an animal whose skin is cut or burnt belong to that class of phenomena known as 'reflex actions;' *i. e.*, they are movements having their origin in impressions made on the terminations of the nerves, and not in impulses coming from the nerve centers in the brain. They may be accompanied by consciousness, but consciousness, so far from being necessary for their production, acts rather to check and interfere with their manifestation.

We are all perfectly well aware that when the spinal cord of an animal has been divided in the cervical region, an impression made upon the nerves of the skin, either by a sharp instrument or a chemical irritant, will cause the animal to execute violent movements of a very definite character, adapted to remove the source of irritation and differing in no respect, except, perhaps in increased energy, from the movements of a perfectly uninjured animal. But in this case we know that the movements are not attended by consciousness, for by division of the spinal cord the channel by which impressions are conveyed to the nerve centers, whose activity is a necessary condition of consciousness, is entirely obliterated. The movements are, in fact, no more indicative of suffering than are the convulsive flutterings of a decapitated chicken. We can speak with great positiveness upon this point, for the testimony of hospital patients suffering from injuries to the spinal cord shows clearly that violent reflex movements of the lower limbs may occur absolutely unattended by consciousness. It is, moreover, a matter of common experience that in certain stages anæsthesia consciousness may be entirely abolished, while the activity of the lower reflex centers remains unaffected. In such cases patients may struggle and scream during an operation, but subsequently declare that they have suffered no pain.

It is evident, therefore, that great caution must be exercised in drawing conclusions with regard to the sensations of animals from the external signs of suffering which they manifest when undergoing operations, and that the 'spasm of agony' of sensational writers is in most cases much better described as a nerve-muscle reaction.

We have thus seen that for the production of a painful sensation three things are necessary:

First, the stimulation of a sensory nerve or its terminations.

Second, the transmission of the stimulus to the nerve centers whose activity is associated with consciousness.

Third, the response of these nerve centers to the stimulus thus received.

Pain may then be defined as the *consciousness of the excessive stimulation of a sensory nerve.* This definition excludes those cases in which the brain is narcotized or separated from the rest of the nervous system, so that there can be no consciousness of the stimulation of the nerve, however severe it may be, and also those cases where the stimulation of the nerve is moderate in amount and therefore gives rise to agreeable sensations. The precise point where

the stimulus of a nerve ceases to be moderate and agreeable and becomes excessive and painful cannot be determined with precision, for a stimulation which is moderate for one individual will be excessive for another or for the same individual at a different time. The strong alcoholic liquor, for instance, which pleasantly titillates the throat of a drunkard, will sear the delicate mucous membrane of the child unaccustomed to its use.

Having thus arrived at a definition of pain and noted that the phenomenon in man and the lower animals is similar in kind though vastly different in degree, we recur to the original question: Have we a right, in studying the phenomena of life, to inflict upon animals whatever pain may be necessary for the attainment of our object? This leads us to consider the broader question, how far it is right that one individual should suffer for the good of another; and this again involves the still broader problem, how far the prospect of future good may compensate for present evil. A full discussion of these questions would carry us far beyond the limits of this discourse. For our present purpose it will be sufficient to note the fact that we unhesitatingly submit ourselves and subject those we love to physical suffering for the sake of future benefit which we think will outweigh the present pain. Nor is this deliberate choice of present evil for the sake of future good limited to those cases in which the evil and the good are both experienced by the same individual. The law of vicarious suffering, by which pain to one individual secures pleasure to another, is a law from whose operation we cannot escape if we would, and, however much we may at times rebel against it, a calm consideration forces us to recognize its stern beneficence. The law which bids us bear one another's burdens, and that which declares that the sins of the fathers shall be visited upon the children, tend powerfully to bind the human race together and contribute perhaps more than any other causes to the development of the moral sense. We see then that there is nothing repugnant to our moral feelings in the abstract idea that one individual should suffer for the benefit of another, and if we accept this principle, as indeed we *must*, when applied to two individuals belonging to the highest grade of sentient creatures, there is still less reason for rejecting it when the suffering individual belongs to a lower grade than the individual who is benefited, since, for the reasons already given, the suffering, in this case, bears a maller proportion to the benefits obtained than when both individuals are equally highly organized. Moreover, when the sufferings of the lower animals have, as a result, not a benefit to a single individual but an increase of human knowledge, the disproportion between the suffering and the benefit becomes practically infinite, for the suffering remains a constant quantity, while the benefit, since it accrues to the whole human race and through all time, is multiplied by an infinite factor.

Admitting, then, that there is no abstract reason why animals should not suffer for the benefit of man, it remains to be considered whether we have a 'right to constitute ourselves administrators of this law of vicarious suffering and to apply it to animals for our own interest.' The right of man to inflict pain upon the lower animals for his own benefit has never been very distinctly formulated. Our relations to the wild denizens of the forest, field and stream are very largely an inheritance from those times when our savage ancestors disputed with the lower animals for the right to exist on the face of the earth. In fact, they do not differ materially, except in degree of complication, from the relation of the lion to the lamb or the hawk to the dove.

In the words of the author of the above

mentioned work on 'Physiological Cruelty,' "It is generally admitted that we may chase and kill an animal, often necessarily with much pain, not because its life and liberty interfere with ours, but because its death will render our life more complete, perhaps in the most trivial detail. We kill them (without anæsthetics) not only that we may have food and clothing, but that the food may be varied and attractive and the clothing rich and beautiful. We subject them to painful mutilations in order to make them more manageable for service, to improve the flavor of their flesh, and even to please our whimsical fancies. We imprison them in cages and zoological gardens, to improve our knowledge of natural history, or merely to amuse ourselves by looking at them. It is abundantly clear that in all our customary dealings with animals we apply to them without scruple the law of sacrifice, and interpret it with a wide latitude in our own favor. * * * So far, the general principle of dealing with animals which is in a vague way accepted by most humane persons * * * seems to be that we may kill, inconvenience or pain them, for any benefit, convenience or pleasure to ourselves, but that the pain must be within moderate limits (of course undefined), and that it must form no element in our pleasure." Now, the point to be specially emphasized in this connection is that physiologists, in experimenting with living organisms, cause an amount of suffering utterly insignificant compared with that which animals are called upon to endure in other ways, and that the suffering thus caused is inflicted with a motive and with an expectation of benefit quite adequate to justify the infliction of a much greater amount of pain that even the most serious operations in the laboratory can be supposed to produce.

In this respect the physiologist stands, it seems to me, on higher moral ground than that occupied by most persons whose occupation leads them to sacrifice animal life. Compare, for instance, the occupation of a sportsman with that of a physiologist. It is difficult to imagine how an animal such as a deer or a rabbit can be made to endure greater physical agony than in being hunted to death by hounds. It is hard to conceive of animal suffering more entirely out of proportion to the object sought and gained by it than that produced by the average sportsman whenever he fires a charge of shot into a flock of birds, since, for every bird actually killed, several more will probably be wounded, and, escaping with broken wings, fall an easy prey to their enemies or perish from starvation. Yet we inflict this suffering, not because we need the animal for food, not because its existence interferes in any way with our own, not because we expect to derive any permanent benefit from its destruction, but simply, as the word 'sport' implies, because we are in search of amusement, and the sufferings of the animal are incidentally associated with our enjoyment of the moment. It must not be supposed that I desire to bring the charge of cruelty against sportsmen, for, of course, the fact that the animal suffers pain forms no part of the pleasure of the hunter; nor do I overlook the great benefit which the sportsman derives incidentally from his pursuit in the acquirement of health, strength and skill. I merely wish to point out, first, that, as far as the charge of cruelty is concerned, the physiologist may claim the same exemption which is accorded to the sportsman, for, so far from enjoying the sufferings of the animals on which he experiments, it is his constant object to reduce those sufferings to a minimum; and secondly, that, with regard to a justification for the infliction of pain, the advantage is on the side of the physiologist, for the desire to enlarge the bounds of human knowledge and to fix

firmly the foundations of the healing art must be regarded as a higher motive than the wish to secure one's own temporary amusement, and moreover the proportion between the benefit obtained and the pain inflicted is much larger in physiological experimentation than in the vocation of the sportsman.

In this connection it is interesting to contrast the fate of the victims of science with that of similar animals living in a state of nature. In doing this we are struck by the vast amount of animal suffering which the laws of nature necessitate. The weak are inevitably the victims of the strong. The chain of destruction extends throughout the animal creation, and every link involves the death of victims under circumstances which, from a human point of view, seem those of revolting cruelty. The cat plays with the mouse, apparently enjoying its terror and distress. The butcher-bird impales its living victims on the thorns of the locust tree, thus laying up in its hideous larder a store of food often far beyond its needs. The larger carnivora tear their living prey limb from limb. In fact, the relations of animals to each other are such as to fully justify, from a moral standpoint, an indictment for cruelty against nature herself. With regard to domestic animals the case is often not much better. The vagrant cur and the prowling cat lead a life of constant terror, eking out a miserable existence amongst piles of garbage, and dying finally, when physical strength fails, from sheer starvation. Compared with misery like this the fate of the chosen victim of science may well be regarded as enviable, for once within the laboratory precincts warmth and abundant food are assured, and, though the term of life is shortened, its closing scene is often absolutely painless, and is, in any case, likely to be attended with less suffering than a so-called natural death.

With regard to physiological experiments which involve operations of a painful nature upon living animals, it is desirable for us to ascertain as accurately as possible the amount of suffering thus caused. The first important fact to be here noted is that the great boon conferred upon mankind in the discovery of anæsthetics extends its beneficent influence over the animal world as well. Just as no modern surgeon ever thinks of performing a severe surgical operation without placing the patient under the influence of ether or chloroform, so no physiologist neglects to use an anæsthetic when performing a prolonged or painful experiment, except in those rare cases in which its administration would interfere with the result of the experiment. Even on the supposition, which too many sensational writers are prone to make, that a physiologist is absolutely regardless of the amount of suffering which he causes, he will still be compelled to use an anæsthetic for his own convenience in order to suppress the cries and struggles of the animal, which would otherwise disturb the adjustment of his delicate instruments and interfere with the mental concentration essential for the proper performance of his work. This very concentration of the mind upon the work in hand prevents, of course, any active feeling of sympathy with the animal experimented upon, but the same may be said of the surgeon who, however tender-hearted he may be, never in operating allows his mind to wander from the work in which his hands are engaged. Neither the one nor the other can be charged with cruelty or inhumanity.

In this connection it may be well to allude to the question whether curare, a drug much used by physiologists, is or is not an anæsthetic. This substance is the arrow poison of certain tribes of South American Indians, and has the property of paralyzing the voluntary muscles. The earlier ex-

periments of Claude Bernard on frogs, showing that sensory nerves are not affected by the poison, led him to the conclusion that an animal poisoned by curare preserves his sensibility to pain, but has lost the power of giving any sign of suffering. Strictly speaking, Bernard's experiments only show that the drug affects the sensory nerves and the spinal cord less readily than the motor nerves, while they throw no light on the question of the persistence of consciousness, but the fact that they succeed equally well after the removal of the cerebral lobes seems to exclude consciousness from any important participation in the phenomena. The arguments which have sometimes been used to sustain the proposition that curare increases the sensibility to pain would prove also that small doses of morphia have the same effect, whereas we know that morphia in small doses diminishes and in larger doses annihilates the sensibility to pain. Thus the weight of physiological evidence seems to be in favor of the view that curare may be to some extent an anæsthetic, though it is not employed by physiologists for that purpose. Psychological evidence pointing in the same direction may also be urged, for, on the theory promulgated and ably defended by Prof. William James, that all emotions are but the conscious recognition of the reflex actions produced by the exciting cause of the emotions, it seems evident that so much of the substratum of the feeling of pain as is dependent upon the reflex contraction of voluntary muscles must, in cases of curare poisoning, be absolutely wanting.

Of the possibly painful physiological experiments which we are now considering, it has been calculated by Prof. Yeo that 75 per cent. are rendered absolutely painless by use of anæsthetics; but it must be admitted that the giving of an anæsthetic to an animal is not the same agreeable operation that it is to a human being. The animal does not understand the reason why it is compelled to breathe a vapor which is gradually depriving it of its consciousness, and usually struggles against the administration of it, thus rendering some sort of forcible confinement necessary. The inconvenience thus occasioned to the animal is, of course, overbalanced in the case of prolonged or serious operations by the exemption from subsequent suffering. When, however, the operation is of a trifling character it is doubtless more merciful to the animal to dispense with the use of anæsthetics. For the complete understanding of this portion of the subject, it should be mentioned that a large portion of the animals thus rendered insensible for physiological purposes are killed after the experiment has been performed and before the effect of the anæsthetic has passed off. Where the object of the research is to observe the subsequent effect of the operation, it is, of course, necessary to allow the animal to recover from the anæsthetic and to endure whatever pain may be connected with the healing of its wounds. This has, however, been reduced to insignificance by the modern methods of antiseptic surgery, the discovery of which was led up to by physiological experiments, and the benefits of which are now experienced by the brute creation as well as by the human race.

Accepting Prof. Yeo's estimate that seventy-five per cent. of the possibly painful physiological experiments are rendered absolutely painless by the use of anæsthetics, it remains to be considered how much suffering attends the remaining twenty-five per cent. of these experiments; and here it is important, in all discusions of this subject, to correct a rather prevalent popular notion that a wound is painful in proportion to its depth. The fact is, however, that sensibility to pain is, in a healthy body, confined almost wholly to the surface. A consideration of the function of

the sensory nerves shows us why this should be the case, for these nerves are distributed only to points where under normal circumstances they can receive stimulation, and thus serve to bring the organism into relation with the outer world. Pain, caused by excessive stimulation of a sensory nerve, is the sign that the integrity of the body is threatened by some external agency, and at this signal the body reacts consciously or unconsciously to ward off the threatened danger. Now external agencies can act upon the body only at the surface. Hence sensory nerves distributed to internal organs would have no *raison d'être*; and, in the wise economy of nature, we find, accordingly, that they do not exist. The apparent contradiction to this statement furnished by the painful sensations, *e. g.*, cramps and colics which we sometimes experience in our internal organs, are really illustrations of the same general law, for the pain in this case is the indication of some *morbid* action of an organ, and is usually the sign that rest is necessary to enable the organ to recover its normal condition. It is a matter of common experience, therefore, that the cutting of the skin is the only really painful part of even quite serious operations. As the knife divides the deeper organs no pain is felt, except indeed when a sensory nerve-trunk is divided, which operation is attended by a momentary flash of pain. Even the brain, the seat of consciousness itself, is no exception to this rule, for its substance may be cut and operated on in various ways without causing the slightest pain. It is evident, therefore, that in a large proportion of the actually painful experiments performed in physiological laboratories the pain must be of the briefest duration, since it is almost wholly confined to the preliminary incision. It must also be borne in mind that a large class of experiments consists in the introduction of drugs under the skin, an operation about as painful as vaccination or as a subcutaneous injection of morphia. Bearing these facts in mind we are well prepared to accept Prof. Yeo's estimate, that of the twenty-five per cent. of actually painful experiments, twenty per cent are about as painful as vaccination, four per cent. about as painful as the healing of a wound, and one per cent. as painful as an ordinary surgical operation performed without anæsthetics.

I have thus sought to set before you the material for forming a judgment with regard to the amount of animal suffering which the practice of experimental physiology involves. It remains for me now to speak of the value of the discoveries thus made, or, in other words, to present to you briefly the evidence of the debt owed by the practising physician of the present day to the physiologists of the past. We shall then be in a position to answer the question whether on the whole 'vivisection pays.' To enumerate all the discoveries that have been made in physiology by means of experiments on animals would be utterly impossible within the limits of this discourse, for there is hardly a single organ of the human body whose functions have not been investigated and explained in this way. It will suffice at this time to call your attention to a few of the more important physiological discoveries which form the groundwork of our knowledge of the human body and to ask you to imagine, if you can, what would be the condition of the healing art if these discoveries had never been made.

To begin with, let us consider the circulation of the blood, the discovery of which bears somewhat the same relation to medicine that that of the law of gravitation bears to physics. It is well known that the ancients believed the arteries, as their name implies, to be tubes containing air. When Galen, in the second century of our

era, studied the arteries in living animals, the fact that they carry blood was, of course, apparent. The circulation of the blood was, however, far from being made out. In fact, it was not till the beginning of the seventeenth century that Harvey, gathering up the learning of the time, contributed by the great Italian teachers, Vesalius, Eustachius, Fallopius, Fabricius of Aquapenbente, and others, and making important additions of his own (as he himself says) 'by frequently looking into many and various living animals,' was finally able to promulgate the true theory of the circulation of the blood. Since the time of Harvey our knowledge of the conditions under which the blood circulates has been greatly extended, and always by means of experiments upon living animals. The pressure which the blood exerts upon the walls of the vessels in different parts of its course has been carefully measured. The fact that its white globules can pass through the vascular walls into the tissues outside has been clearly demonstrated, and forms, in fact, the basis of the modern theory of inflammation. The influence of the nervous system in controlling the size of the channels through which the blood circulates, thus regulating the nutrition of the tissues, the activity of the organs and the distribution of the heat, has been studied by a host of observers, and is, indeed, one of the most fruitful fields of modern physiological research. It is difficult to imagine what the practice of medicine would be without this knowledge, which has been wholly obtained by experiments on living animals and which is now the common property of educated physicians. It has, indeed, been very pertinently asked: "How will those earnest anti-vivisectionists, who, like Miss Cobbe, prefer to 'die sooner than profit by such foul rites,' provide themselves with a medical attendant warranted ignorant of the circulation of the blood?"

The direct benefits received from animal experimentation are, perhaps, more obvious in surgery than in the other departments of medicine. The proper mode of applying ligatures to arteries and the antiseptic treatment of wounds have reached their present stage of perfection largely through experiments on the lower animals. To give you a vivid idea of the privileges which we are now enjoying, I will ask you to listen to Ambros Paré's description of an amputation as performed in his time: "I observed my masters, whose method I intended to follow, who thought themselves singularly well appointed to stanch a flux of blood when they were furnished with various store of hot irons and caustic medicines, which they would use to the dismembered part, now one, then another, as they themselves thought meet, which thing cannot be spoken or but thought upon without great horror, much less acted. For this kind of remedy could not but bring great and tormenting pain to the patient, seeing such fresh wounds made in the quick and sound flesh are endured with exquisite sense. * * * And verily, of such as were burnt, the third part scarcely ever recovered, and that with much ado, for that combust wounds with difficulty come to cicatrization; for by this burning are caused cruel pains, whence a fever, convulsion, and ofttimes other accidents worse than these. Add hereunto that, when the eschar fell away, ofttimes a new hæmorrhage ensued, for stanching whereof they were forced to use other caustic and burning instruments. * * * Through which occasion the bones were laid bare, whence many were forced, for the remainder of their wretched life, to carry about an ulcer on that part which was dismembered; which also took away the opportunity of fitting or putting to an artificial leg or arm, instead of that which was taken off."

Let us now contrast this ghastly picture

with the methods of a modern amputation. The patient is first made unconscious by the use of ether or chloroform. The blood vessels of the limbs are then emptied by means of an elastic bandage. Hardly a drop of blood is shed in the amputation itself; the divided arteries are firmly tied and the wound, treated antiseptically, heals with little or no pain. At every step in the process which has led to this brilliant result experiment has been the guide. Various technical details of the method remain still to be worked out. It is this beneficent work which anti-vivisectionists seek to abolish.

I will allude to but one other benefit conferred upon suffering humanity by scientific experiment involving the sacrifice of animal life: The therapeutic use of anti-toxine, though still in its infancy, shows by the unimpeachable records of hospital practice that the physician has now within his grasp the means of successfully treating one of our most dreaded diseases. The anxiety, almost amounting to despair, with which a physician formerly approached a serious case of diphtheria, has given place to a feeling of well grounded hope of a favorable result. Who can estimate the burden of terror and distress thus removed from the anxious watchers by the bedside, and who will dare to say that the boon has been dearly purchased by the lives of some thousands of guinea pigs?

Let us now briefly review the points over which we have already passed. We have seen, in the first place, that pain is a purely subjective phenomenon, the sensibility to which differs very much in different individuals and is in the lower animals reduced apparently much below that of the least sensitive human beings, and that, moreover, the external signs of suffering are apt to be misleading, unless the conditions under which these signs are made are well understood, a knowledge which can be acquired only by careful physiological study. We have seen, in the second place, that pain is only relatively an evil, that we submit to it ourselves and subject others to it for the sake of subsequent advantages which we consider sufficiently important. Thirdly, we we have seen that our relations to animals are such that there is no well recognized objection to our causing them very great suffering for the sake of very slight benefits to ourselves. In this matter there is, of course, great room for improvement. The practical question always is "how much suffering may we inflict on an animal for the sake of how little benefit to ourselves?" In the progress of civilization there is a constant tendency to draw the line more and more in favor of the animal, but when we remember how much opposition there was, within a few years, arrayed in this State against the passage of a law to abolish pigeon shooting we cannot flatter ourselves that we have, as yet, reached any very advanced humanitarian standpoint. It is certainly no very extravagant concession to the rights of animals to enact that they shall not be set up as living targets at a shooting match, when glass balls thrown into the air will answer the same purpose. In forming and fostering a public opinion which demands a greater consideration for the brute creation the societies for the prevention of cruelty to animals have played an important part, and their work would doubtless be still more effective were they in the habit of making more frequent applications of the results of physiological research to the problems of animal life. By the efforts of these societies and by the general growth of humane sentiments in the community, we may expect that a larger and larger prospective benefit will be demanded as a justification for the infliction of pain upon animals. To this raising of the requirements of humanity physiologists will

be certain to offer no objection, provided the same rule is applied to all occupations involving pain to animals; for it is evident, I trust, from what has been said, that a standard so high as to be practically inapplicable to the daily affairs of life will still leave a wide margin for the carrying on of physiological research. A questionable practice cannot of course be justified by demonstrating that another and still less justifiable practice exists, but it may be fairly urged that, while practices are permitted which cause great suffering to animals with only incidental benefits to mankind, "it is irrational folly," to quote a writer in *Nature*, "to waste the energy of humanitarian feeling in a warfare against the only kind of pain-giving practice which is directed toward the mitigation of pain, and which has already been successful in this its object to a degree out of all proportion to the pain inflicted."

Enough has been said, I trust, to demonstrate the expediency of permitting physiological research to go on unchecked, and even of encouraging it, in every possible way, as the only legitimate basis of scientific medicine. Before leaving the subject, however, it is well to notice that, whatever restrictions be imposed on the physiologist working in his laboratory, the advancement of medicine by experiment will be certain to go on. Agitation cannot check it. Legislation cannot prevent it. Once admit, what no one thinks of disputing, that physiological phenomena are chemical or physical in their character, and the position of physiology among the experimental sciences is a matter of necessity. All that legal enactments can do is to determine to some extent who shall be the experimenters and who the victims of the experiments. Shall practicing physicians grope blindly in search of methods of treatment when chance brings disease under their observation, or shall men of science, systematically studying the nature and results of morbid processes in animals, point out to the practitioner the path to be followed to render innocuous the contagion of our most dreaded diseases? In illustration of this point, permit me to quote a few lines from Dr. John Simon's address on State Medicine: "The experiments which give us our teaching with regard to the causes of disease are of two sorts; on the one hand, we have the carefully pre-arranged and comparatively few experiments which are done by us in our pathological laboratories, and for the most part on other animals than man; on the other hand, we have the experiments which accident does for us, and, above all, the incalculably large amount of crude experiment which is popularly done by man on man under our present ordinary conditians of social life, and which gives us its results for our interpretation. * * * Let me illustrate my argument by showing you the two processes at work in indentical provinces of subject-matter. What are the classical experiments to which we chiefly refer when we think of guarding against the dangers of Asiatic cholera? On the one side there are the well-known scientific infection experiments of Prof. Thiersch, performed on a certain number of mice. On the other hand, there are the equally well-known popular experiments which during our two cholera epidemics of 1848–49 and 1853–54 were performed on a half a million of human beings, dwelling in the southern districts of London, by certain commercial companies which supplied those districts with water. Both the professor and the water companies gave us valuable experimental teaching as to the manner in which cholera is spread. * * * Now, assuming for the moment that man and brute are of exactly equal value, I would submit that, when the life of either man or brute is to be made merely instrumental to the establishment of a scientific truth,

the use of the life should be economical. Let me, in that point of view, invite you to compare, or rather to contrast with one another, those two sorts of experiments from which we have to get our knowledge of the causes of diseases. The commercial experiments which illustrated the dangerousness of sewage-polluted water supplies cost many thousands of human lives; the scientific experiments which, with infinitely more exactitude, justified a presumption of dangerousness cost the lives of fourteen mice."

We see, then, that in one way or another experiment must form the basis on which medical science is to be built up. The question for us to decide is, "Shall these experiments be few, carefully planned, conclusive, economical of animal life, or shall they be numerous, accidental, vague and wasteful of human life?" I think in settling this question we may safely take for our guide the words of Him who said, "Ye are of more value than many sparrows."

H. P. BOWDITCH.

THE DECORATIVE ART OF THE INDIANS OF THE NORTH PACIFIC COAST.

IT is well known that the native tribes of the North Pacific coast of America ornament their implements with conventionalized representations of animals. The tribes of this region are divided in clans which have animal totems, and it is generally assumed that the carvings represent the totem of the owner of the implement. This view is apparently sustained by the extensive use of the totem as a crest. It is represented on 'totem poles' or heraldic columns, on the fronts of houses, on canoes, on the handles of spoons, and on a variety of objects.

It can be shown, however, that by no means all the carvings made by the natives of this region have this meaning. A collection of data made in a number of museums show that certain objects are preferably ornamented with representations of certain animals, and in many cases an intimate connection exists between the use to which the object is put and its design.

This is very evident in the case of the fish club, which is used for despatching halibut and other fish before they are hauled into the canoe. Almost all the clubs that I have seen represent the sea lion or the killer whale, the two sea animals which are most feared by the Indians, and which kill those animals that are to be killed by means of the club. The idea of giving the club the design of the sea lion or killer whale is therefore rather to give it a form appropriate to its function and perhaps secondarily to give it by means of its form great efficiency. This view is corroborated by the following incident which occurs in several tales: A person throws his fish club overboard and it swims away and kills seals and other sea animals, cuts the ice and performs other feats taking the shape of a sea lion or of a killer whale. Here also belongs the belief recorded by Alexander Mackenzie (Trans. Roy. Soc. of Canada, 1891, Sec. II., p. 51): "The Haida firmly believe, if overtaken by night at sea and reduced to sleep in their canoes, that by allowing such a club to float beside the canoe attached to a line it has the property of scaring away whales and other monsters of the deep which might otherwise harm them."

Here is another instance in which I find a close relation between the function of the object and its design. Small grease dishes have almost invariably the shape of the seal or sometimes that of the sea lion, that is, of those animals which furnish a vast amount of blubber. Grease of sea animals is considered as the sign of wealth. In many tales abundance of food is described by saying that the sea near the houses was covered with the grease of seal, sea lion and whales. Thus the form of the seal seems to symbolize affluence.

Other grease dishes and food dishes have the form of canoes, and here I believe a similar idea has given rise to the form. The canoe symbolizes that a canoe load of food is presented to the guests, and that this view is probably correct is indicated by the fact that in his speeches the host often refers to the canoe filled with food which he gives to his guests. The canoe form is often modified, and a whole series of types can be established forming the transition between canoe dishes and ordinary trays. Dishes of this sort always bear a conventionalized face at each short end, while the middle part is not decorated. This is analogous to the style of the decoration of the canoe. The design represents almost always the hawk. I am not certain what has given origin to the prevalence of this design. On the whole the decoration of the canoe is totemistic. It may be that it is only the peculiar manner in which the beak of the hawk is represented which has given rise to the prevalence of this decoration. The upper jaw of the hawk is always shown so that its point reaches the lower jaw and turns back into the mouth. When painted or carved in front view the beak is indicated by a narrow wedge-shaped strip in the middle of the face, the point of which touches the lower margin of the chin. The sharp bow and stern of a canoe with a profile of a face on each side, when represented on a level or slightly rounded surface, would assume the same shape. Therefore, it may be that originally the middle line was not the beak of the hawk, but the foreshortened bow or stern of the canoe. This decoration is so uniform that the explanation given here seems to me very probable.

On halibut hooks we find very often decorations representing the squid. The reason for selecting this motive must be looked for in the fact that the squid is used for baiting the hooks.

I am not quite certain if the decoration of armor and weapons is totemistic or symbolic. Remarkably many helmets represent the sea lion, many daggers the bear, eagle, wolf and raven, while I have not seen one that represents the killer whale, although it is one of the ornaments that are most frequently shown on totemistic designs.

I presume this phenomenon may be accounted for by a consideration of the ease with which the conventionalized forms lend themselves to decorating certain parts of implements. It is difficult to imagine how the killer whale should be represented on the handle of a dagger without impairing its usefulness. On the other hand, the long thin handles of ladles made of the horn of the big horn sheep generally terminate with the head of a raven or of a crane, the beak being the end of the handle. This form was evidently suggested by the slender tip of the horn, which is easily carved in this shape. The same seems to be true in the cases of lances or knives, the blades of which are represented as the long protruding tongues of animals, but it may be that in this case there is a complex action of a belief in the supernatural power of the tongue and in the suggestions which the decorator received from the shape of the object he desired to decorate.

To sum up, it seems that there are a great number of cases of decoration which cannot be considered totemistic, but which are either symbolic or suggested by the shape of the object to be decorated. It seems likely that totemism was the most powerful incentive in developing the art of the natives of the North Pacific coast; but the desire to decorate in certain conventional forms once established, these forms were applied in cases in which there was no reason and no intention of using the totemistic mark. The thoughts of the artist were influenced by considerations foreign to the idea of totemism. This is one of the numerous ethnological pheno-

mena which, although apparently simple, cannot be explained psychologically from a single cause but are due to several factors.

FRANZ BOAS.

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*RECENT HYDROGRAPHIC EXAMINATIONS IN THE APPALACHIAN AREA.**

THE systematic study of the discharges of the streams of the United States has, with one or two exceptions, been undertaken only in recent years. The expense and time required for such investigations prohibits the private engineer from undertaking them, and they can be carried on, therefore, only by large corporations, municipal or State authorities, or by the National Government. Among the most valuable contributions to this branch of engineering have been investigations ordered by the cities of Boston and New York in connection with the study of their water supply. The Sudbury records for Boston supply data since 1875 and those of the Croton for New York since 1868. These are on relatively small basins, however, the former having a drainage area of 78 square miles and the latter 353 square miles.

The army engineers in connection with the improvement of the Connecticut river carried on systematic observations of the discharge of that river at Hartford, Conn., from 1871 to 1879, inclusive, and from that period to the present time the Holyoke Water Power Company have continued the observations. The company in charge of the water powers at Lowell and Lawrence, Mass., on the Merrimac river, have carried on measurements of discharges for over fifty years, but their engineers have published little information. The State of New Jersey, in the interest of her water powers, and the city of Philadelphia, for the future development of her water supply, commenced seven and nine years ago, respectively, the study of certain drainage basins, but they are also relatively small areas. The U. S. Geological Survey, in May, 1891, established a gauging station on the Potomac at Chain Bridge, D. C., for the measurement of the discharge of the river at that place. It was started somewhat as an experimental station, the time given to it being that which could be spared by hydrographers from office work. Gauge height observations were continued until the end of 1893, when, on account of lack of time and of funds, they were discontined.

It has for years been the desire of the hydrographers of this survey to make a thorough and detailed study of the drainage system of one large river, to measure its different tributaries, and to study the relation of their discharges to that of the entire system. An opportunity was afforded for the development of this plan in the spring of 1894, and the Potomac basin was chosen as being convenient of access and as typical of large areas along Appalachian range. Gauging stations were established as follows: First, on the North Branch at Cumberland, Md.; second, on the South Branch three miles above Springfield, W. Va.; third, at Dam No. 6, ten miles above Hancock, Md.; fourth, one on the Shenandoah at Millville, W. Va., five miles above its mouth, and fifth, one on the main river at Point of Rocks, Md. Daily observations of the height of the river at Chain Bridge were also resumed, but measurements of the discharge were not made, as it was found that this point was not a favorable location for such measurements. In high water the velocity is too great, owing to the restricted channel, and in low water the daily tides introduce errors that are hard to eliminate. Work was actively prosecuted in this basin during the past spring, and a sufficient number of gaugings were made to construct

* Read before the National Geographic Society, November 15, 1895, by F. H. Newell, U. S. Geological Survey, Washington, D. C.

rating curves for each station, by means of which the daily discharge can be computed.

In July, 1895, it was decided to expand the work of stream measurements in the South. Before doing so many factors entering into the location of gauging stations had to be considered. To more clearly understand the reasons of the location of the stations established during 1895, it may be well to give a brief summary of the physical geography of the area.

The region under consideration may be divided into four great divisions. The coastal plain, extends from the coast to what is known as the fall line, and consists of very recent geologic formations, principally sands and gravels of Cretaceous, Tertiary and Post-Tertiary deposits. This fall line is the eastern outcrop of the old Archæn crystalline rocks of the second or Piedmont division, which extends to the summits of the Blue Ridge, and it also marks the last considerable fall on the rivers that cross it. It passes through Columbus, Macon, Milledgeville and Augusta, Ga., Columbia, S. C., Rocky Mount and Weldon, N. C., then through Richmond and Fredericksburg, Va., crossing the Potomac at Great Falls. It thence extends further northeastward and is finally lost at the mouth of the Hudson river. In the northern portion this fall line determines the limit of tide waters, but in the Southern States as it recedes from the coast it is often beyond the limit of navigation. The third division of this region is the greater Appalachian valley, extending from the Blue Ridge to the crest of the Allegheny front, and the fourth division is the Allegheny plateau, gradually sloping downward and westward from this latter boundary line. The greater Appalachian valley is a depressed zone traversed by a number of parallel ridges, and it is composed of a variety of different kinds of rocks, as conglomerates, sandstones and limestones, the beds of which are tilted at various angles. In the Allegheny front and to the westward the strata are seen to be nearly parallel.

The Piedmont section is the oldest of the four divisions above noted, the rocks dating from Archæan times. The Blue Ridge, the western boundary of this section, is the coast line of an old continent, but of a continent facing westward and towards an inland sea. The greater Appalachian valley would, therefore, represent the shore deposits of such a sea, and one would naturally expect to find rocks diversified in color and composition along such a strip. Further to the westward or out into the sea should be and are found rocks of a more homogeneous character.

In establishing the gauging stations during 1894 and 1895 it has been the endeavor to distribute them as much as possible in these different types of areas. An important consideration has been that of the economic value of such stations. Wherever there has been a water-power privilege developed, and especially when there is one undeveloped on the larger rivers a gauging station has been established as near such a site as possible. In the accurate determination of the value of a water power at a certain point two things should be known: first, the fall at that place, which can be measured once and for all; and second, the variation in the discharge of the river to determine which a long series of observations are necessary.

It has been too often the practice to compute the amount of water finding its way into the rivers, by assuming a certain percentage of the rain falling on the area as drained by the river at that point. Several important factors enter into the problem of run-off, beside the rate of precipitation, these being the slope of the basin, the temperature, wind movement and the conditions

of soil. Thus two adjoining basins, receiving the same amount of rain, but differing, in slope or in the nature of their soils, or both, will also differ more or less in their run-off. An examination of the Georgia streams has shown that highly deceptive results would be had if for two neighboring basins a certain percentage of rain were taken as giving the run-off.

A limiting factor in the location of gauging stations is the cost and accessibility of such stations. Nearly all of the United States Geological Survey gauging stations in the eastern United States are at railroad or highway bridges. Much of the field work of 1895 has consisted in inspections of such crossings. Where a suitable locality filling the engineering requirements was found, measurments of the discharge were made and there was established a gauge rod on which the height of the river could be read daily by a man employed for the purpose and who usually resided near the bridge.

To obtain the best results the river at a measuring station should have a regular and smooth bottom, the water should have a velocity that can be measured by current meters and the channel should be straight for some distance above and below.

It seems as though bridges had been erected at points in order that gaugings could not be made from them. Either the bridge extended diagonally across the river or it was over a pool of water with little current, as in the case of the ponding of a river by a dam, or the section of the river under the bridge was rocky and filled with obstructions.

A general reconnoissance was made in July, 1895, through Virginia and West Virginia, for the purpose of inspecting the head waters of the Shenandoah, James and New rivers. As a result two stations were established at Port Republic, Virginia, one on the South Branch and the other on the North Branch of the South Fork of the Shenandoah. These stations in connection with the one at Millville, Virginia, furnish data for the satisfactory study of this stream. On the James River stations were established on the North Fork near its mouth and on the main river at Buchanan, twenty miles above the mouth of this fork. The sum of the discharges at these two points will give the discharge of the James at Balcony Falls, the point where it breaks through the Blue Ridge and where there is a fine undeveloped water-power privilege. Passing over the divide to the head waters of the New, a tributary of the Ohio River, a station was established at Alderson, West Virginia, on the picturesque Greenbrier River, and one on the New at Fayette, West Virginia. This latter river is a torrential stream, in places widening to 2,000 feet, as at Hinton, but lower down on its course, as the surrounding mountains close in, contracting to 200 or 300 feet in width. In such places the river even in low water tumbles and foams over its rocky bottom.

By the examination of a contour map of the Appalachian region, it will be seen that the rivers draining the Appalachian valley in the northern portion, as the Susquehanna, Potomac, James and Roanoke, have a general eastward course, the divide between the Atlantic coast streams and the tributaries of the Mississippi being along the Allegheny front. Passing into North Carolina, the divide bends southeastward to the summits of the Blue Ridge. Here the Appalachian valley drainage is to the westward. After a thorough inspection of the French Broad a station was established at Asheville, North Carolina. This river is not a typical mountain stream, the valley above Asheville is comparatively broad and has little fall. The rivers to the south, as the Tuckaseegee and Little Tennessee, are more nearly typical mountain torrents,

but owing to their inaccessibility it was not deemed advisable to establish stations on them during 1895.

The rivers of North Carolina flowing eastward and above the fall line have many large undeveloped water-power privileges. The Yadkin River at the Narrows, about 35 miles below Salisbury, is perhaps the finest water power in the State. The river just above the canyon is 1,000 feet wide, but as it enters the gorge it suddenly contracts to a width of 75 feet, and in some places even to 30 feet. In two miles the river falls 60 feet and in four miles about 110 feet. The nearest accessible point to the Narrows where a gauging station would be established was at the Southern Railroad crossing near Salisbury. The discharge as measured here last September was 1,450 second feet or a discharge of 0.43 cubic feet per second per square mile of area drained. The past season has been one of extreme low water, and this result is large compared to the run-off of more northern rivers. In fact, all of these sand-hill streams of the Southern States have a large low-water flow. The sandy soils of their basins acting as sponges absorb the spring rains and let the water off gradually in the summer time. A station was established in 1895 on the basin of the Catawba at Fort Mill, South Carolina, also one on the Cape Fear at Fayetteville, North Carolina, and two at Clarksville, Virginia, one on the Dan and the other on the Staunton.

A partial inspection of Georgia has been made and two stations established in the State on the two most important rivers, the Chattahoochee and the Ocmulgee. The former stream is peculiar in having a very high summer flow. The gauging on October 15, 1895, near Atlanta gave a discharge of 0.69 cubic feet per second per square mile of area drained. A comparison of this run-off with the minimum flow of some other rivers is as follows:

	Drainage Area in Square Miles.	Second Feet per Square Mile.
Sudbury, Mass.,	78	0.04
Pequannock, N. J.,	63	0.13
Ramapo, N. J.,	160	0.14
Paulinskill, N. J.,	126	0.13
Neshaming,	139	0.01
Merrimac, Mass.,	4,600	0.31
Connecticut, Conn.,	10,234	0.31
Potomac, Va.,	9,654	0.12
Shenandoah, Va.,	2,995	0.30
Yadkin, N. C.,	3,399	0.43
Catawba, S. C.,	2,987	0.45
Ocmulgee, Ga.,	2,250	0.34
Oconee, Ga.,	2,973	0.36
Chattahoochee, Ga.,	1,600	0.69

Cyrus C. Babb.

AN ASTRONOMICAL CIPHER CODE.

In the last number of the publications of the Astronomical Society of the Pacific, Prof. Holden prints a suggested improvement upon the Science Observer Cipher Code, devised by Messrs. Ritchie and Chandler, that has been in use by astronomers for the transmission of telegraphic announcement of astronomical discoveries during the past twelve years.

It will be remembered that this very important matter of prompt transmission of astronomical intelligence was effected through the Smithsonian Institution from 1873 to 1883, and in the latter year arrangements were concluded by which the service was transferred to the observatory of Harvard College, the observatory thus becoming the central station for astronomical announcements in this country. A most useful code for the accurate and economical transmission of telegrams had been devised by Ritchie and Chandler, and was subsequently improved upon from time to time, and finally issued in 1888 in the shape of the Science Observer Code Book, a quarto of some 235 pages. The bulk of this is taken up by a number code covering two hundred pages and containing forty thousand words in all. The principle

adopted is that each word shall differ by at least two letters from every other word in the code, and no word of more than ten letters shall be included. The words are taken from all languages, many of them from the Spanish, and the difficulty that seems to have suggested to Prof. Holden the desirability of a change has come from the common use of the telephone in the transmission of telegraphic messages to the observatory.

The words of the despatch have to be spelled out over the telephone, and in many cases the code words are entirely meaningless to the ordinary operator. Prof. Holden suggests a condensation of the code by which the forty thousand words, occupying two hundred pages, may be covered by two octavo pages, the first consisting of five hundred prefixes, and the second of ninety-nine affixes; the prefixes each of three letters, and the ninety-nine affixes each of five letters; so that by these two tables any number of five figures less than fifty thousand can be made up of a cipher word always of eight letters. It produces, of course, pure jargon, but this is no worse than most of the words in the old code.

The idea of control words to insure the accuracy of the telegraphic transmission of important data, due to Ritchie and Chandler, is, of course, retained in the suggested modification of the code published by Prof. Holden, as well as the list of phrases of the original code.

Prof. Holden publishes as an appendix to his code the circular of the Central Bureau of astronomical telegrams of Europe, from Prof. Kreutz, of the Kiel Observatory, which has not apparently been published hitherto in America.

CURRENT NOTES ON PHYSIOGRAPHY.

ICE WORK, PAST AND PRESENT.

PROF. T. G. BONNEY, of the University College, London, contributes a work of the above title to the International Scientific Series (Appleton, 1896). Its three parts discuss existing evidence of ice work from Alpine, Arctic and Antarctic glaciers, traces of the glacial epoch, and theoretical questions. The two first parts are not clearly separated, for the ancient moraines of Switzerland are described under both. Although containing much interesting material, the work is rather disappointing in its deficiency of thoroughly scientific quality. No one could learn from the associated accounts on the Deckenschotter of the Uetliberg and the Zurich moraine that an enormous erosion interval separated the forma- of the two deposits, and that the former is only a remnant of a widespread sheet of drift. After the habit of the English school, the geological structure of till is largely dwelt upon, with too brief explanation of its geographical effects. A disproportionate amount of space is given to the Parallel Roads of Glen Roy; and too much authenticity is allowed to Lake Ohio by the reproduction of Claypole's hypothetical map, without reference to the very grave doubts that have been expressed as to its verity. Some once-controverted but now-settled questions are treated in a still doubting manner that hardly represents the present status of glacial geology.

DISSECTED BASALT PLATEAUS OF NORTH-WESTERN EUROPE.

SIR A. GEIKIE, for many years a student of the ancient volcanic rocks of Scotland and neighboring countries, now presents an outline of his results. (Quart. Journ. Geol. Soc., LII., 1896, 331–405.) These are largely concerned with structural features—the lava flows, the vents, the sills and dikes, the gabbro and granophyre intrusions—but they also include matters of physiographic interest—the rivers of the volcanic period, the effects of denudation, and particularly the parallel drawn with modern volcanic

action in Iceland, as illustrative of the Tertiary condition of western Scotland. Not from central vents, like Vesuvius and Etna, but from fissures, have the Icelandic lavas been chiefly poured forth; the volcanic cones there are generally low, and yet from these little monticules great floods of lava have issued, forming wide volcanic plains. Plateaus are thus built up, suffering more or less dissection as they grow, sometimes assuming the form of vast domes with gentle slopes to all sides. Great volcanic plateaus of similar structure once existed where dissected remnants now form Skye, Mull and other island outliers west of Scotland or further north in the Faroes. Correlations of this kind between regions of similar structure, but in different stages of geographical development, are particularly instructive to the study of physiography.

THE GEOGRAPHY OF SILESIA.

Prof. Joseph Partsch, of the University of Breslau, has lately prepared a volume on Silesia (Schlesien: eine Landeskunde für das deutsche Volk auf wissenschaftliche Grundlage; Breslau, Hirt, 1896. 420 p.) to which the special student of European geography may refer with much advantage. It treats, among other topics, of geological structure, evolution of the land surface, drainage, climate, plants, animals, population, and Silesia as a seat of war. The plan of the more strictly geographical chapters is similar to that followed in the same author's work on Greece jointly with Naumann; that is, each subdivision is directly described for itself, rather than in its systematic relation to other geographical areas of similar structure, but perhaps in different stages of geographical development. The chapter on the evolution of the land surface is essentially a geological history of the region; not limited to the evolution of the existing surface forms, but beginning with the fundamental gneiss. The importance of northern drift as a factor in determining surface form even so far south as to the Beskiden (Carpathians) in latitude 50° is for some reason more surprising than it should be to us, who have plentiful glacial drift in latitude 40°.

NOTES.

Boule's work on the glaciation of Auvergne, noted in Science, April 17, 1896, from his brief report in the *Comptes rendus*, is now more fully described in the *Annales de Géographie*, v., 1896, 277–296, with excellent illustrations and several maps. This article would lead the scientific tourist to many points of interest in the neighborhood of the great volcanic slopes of the Cantal.

W. F. Ganong describes a delta at the outlet of Lake Utopia, New Brunswick, formed when its outflow of clear water is reversed to inflow of muddy water at time of flood in the neighboring Magaguadavic river (Occasional papers, No. 2,* New Brunswick Nat. Hist. Soc.).

W. M. Davis.

Harvard University.

CURRENT NOTES ON ANTHROPOLOGY.

A STUDY OF THE BASQUES.

One of the memoirs published last year by the Anthropological Society of Paris was by Dr. Collignon, on the Basques. The thorough manner in which that investigator does his work is well known to all students of the ethnography of France, and the present memoir is a good example of it. He begins by referring to the obscurity which has reigned concerning both the physical type of the Basques and the affinities of their tongue. His own personal ob-

* Protest should be entered against the publication by the Council of the above-named Society of such stray leaves as this 'Occasional paper, No. 2.' There are to-day plenty of regularly established mediums of publication in which two-page essays may be issued, thus avoiding the serious difficulty of preserving and protecting loose sheets.

servations are numerous and accurate. They lend solid support to the conclusions he advances, the most interesting of which are as follows: 1. The Basques present a definite physical type not encountered elsewhere in Europe and limited to their linguistic boundaries. 2. There is sufficient evidence that they migrated into France from the Iberian peninsula since the fall of the Roman Empire, and therefore the ancient Aquitanians, Ligurians, etc., were not Basques, as has so often been maintained. 3. The general anatomical peculiarities of the Basques separate them distinctly from the Asiatic or Mongolian type, and stamp them as European. 4. Their earliest home must have been in some part of the Iberian peninsula, but there is no proof that they at any time occupied all of it. Nor is it possible to say that the Basque was the primitive speech of this people. It may have been forced upon them by some conquering tribe now disappeared.

THE TOLTECS IN FABLE AND HISTORY.

THERE are still some writers who believe in the fabulous 'Empire of the Toltecs,' the shadowy realm which in Mexican myth extended its dominion over vast areas and millions of men. The historical aspects of the question are examined anew by Dr. P. J. J. Valentini in the *Zeitschrift für Ethnologie*, No. 1, 1896.

He begins by denying the legends of the Mexican chroniclers. 'There was neither an empire, nor a nation, nor a language of the Toltecs.' He pursues his inquiry along the line principally of the Mayan traditions, and analyzes with acuteness the confused accounts they have preserved. Evidently to them, Tulan or Tula was a sort of generic term and was applied to various localities. Although usually derived from the Nahuatl, it may also be explained from Mayan radicals, with equal if not greater appropriateness. In a later and general sense he believes that it answered to the notion of town or city, as contrasted to country, and consequently of all that is civil and urbane as opposed to rustic; just as we see in these Latin terms.

The article is accompanied with a map showing the location of tribes and towns in Chiapas and vicinity, and its arguments will aid in clearing away many visionary notions about this alleged ancient people.

D. G. BRINTON.

SCIENTIFIC NOTES AND NEWS.

ASTRONOMY.

THE observatory of Yale University has published the fifth part of the first volume of its 'Transactions.' It contains the results of a heliometric triangulation of the principal stars of the cluster in Coma Berenices by Dr. F. L. Chase. The final result is a catalogue of the places of thirty-three stars for the epoch 1892.0.

IN the *Astronomical Journal* of June 29th Dr. See communicates the elements of the orbits of forty binary stars computed by himself. The table of elements is of interest because all the orbits have been obtained by a nearly uniform process. Dr. See finds that the average excentricity of the forty stars considered is 0.45, but he draws no other general conclusions as to the general characteristics of binary star orbits.

IN the *Astronomical Journal* of July 8th Dr. S. C. Chandler publishes his third catalogue of variable stars. Progress in this department of astronomical science has been so rapid of late, that it has not been possible to keep pace with new discoveries by merely issuing supplements to the former catalogue of variables. The following paragraph of Dr. Chandler's introduction to his catalogue is not without interest. Dr. Chandler says:

"Very few stars within reach of the astronomers of the northern hemisphere, who have so actively devoted their energies to this class of work, have been seriously neglected. It is especially interesting to note the fact that this harmonious development has been obtained without any concerted scheme of 'cooperation,' but by the free will and independently planned

efforts of individual volunteers, each discriminatingly directing his work in accordance with his means and situation. Such a satisfactory result could hardly have been reached so effectively by a formal organization of work, directed from headquarters prescribing and circumscribing the operations of each participant, and destroying, by its benumbing influence, the enthusiasm which springs from the individual initiative of the observers themselves."

We are inclined to ascribe this paragraph to Dr. Chandler's modesty, for there can be no doubt that the satisfactory progress of variable star astronomy in the United States has been the result of just such cooperation as Dr. Chandler mentions. And the supervision of the whole work has been largely in his own hands. We do not think he has had a 'benumbing influence' on the observers. Variable star astronomy furnishes a conspicuous example of the benefits to be derived from intelligent cooperation, acting with the advice or informal direction of a competent central authority.

Prof. Helmert, director of the Central Bureau of the International Geodetic Commission, has issued a circular concerning the proposed operations for the more complete study of the variation of terrestrial latitudes. It will be remembered that the International Commission has had under consideration a project for the establishment of four latitude stations on the same parallel of latitude, but distributed in longitude as nearly as possible equally around the earth. No definitive decision has been reached in the matter, but the present circular is accompanied with a carefully prepared paper by Prof. Albrecht, dealing with the question of the best possible selection of stations for the proposed work. It appears from Prof. Albrecht's paper that the best results will be secured if two of the stations are located in the United States, one in Japan and the other in or near the island of Sicily. H. J.

THE DAVY-FARADAY RESEARCH LABORATORY.

In the issue of *Nature* of July 2d will be found an account of the laboratory for research in physics and chemistry presented to the Royal Institution by Dr. Ludwig Mond. Dr. Mond formally transferred to the managers of the Royal Institution, on June 12th, a building adjoining the Institution which has been arranged and equipped with the necessary apparatus for the most exact investigation.

The Laboratory contains on the basement a room for thermochemical research; a room for pyrochemical research; mechanics' workshop; room for electrical work; battery of twenty-six accumulators; constant temperature vaults; boiler-house and store-rooms. On the ground floor, a room for research in organic chemistry; a room for research in inorganic chemistry; a fire-proof room for experiments in sealed tubes; a balance room; entrance hall and cloak room. On the first floor, the Honorary Secretary's room; a large double library connected with the library of the Royal Institution. On the second floor, a museum of apparatus. On the third floor, seven rooms for research in physical chemistry. On the fourth floor, a room for inorganic preparations; a room for organic preparations; a photographic room; four rooms for researches in physical chemistry. On the roof, an asphalted flat with a table, gas and water.

Dr. Mond has not only furnished the laboratory with the most modern instruments and appliances for research in pure and physical chemistry, but he has also placed in the hands of the managers of the Royal Institution an ample annual endowment, so that the laboratory may be maintained in a state of thorough efficiency, the object of the donor being to give every assistance and encouragement within the limits of the endowment to scientific workers. The laboratory (the affairs of which will be managed by a laboratory committee appointed by the managers of the institution) will be under the control of two directors, who will be aided in the work by competent assistants. The managers of the Royal Institution have appointed as directors Lord Rayleigh and Prof. Dewar. It is intended to open the laboratory for work by the middle of October. The trust deed provides that no person shall be admitted to the laboratory as a worker who has not already done original scientific work, or in the alternative, who is not, in the opinion of the laboratory committee, fully qualified to undertake original scientific research in pure or

physical chemistry; and that no person shall be excluded from admission by reason of his or her nationality or sex.

NERVOUS DISEASES AND MODERN LIFE.

THE *Century Magazine* for May contains an article by Dr. Philip Coombe Knapp, in which he claims that there is no definite scientific basis for the common assumption that nervous diseases are increasing and that they are more prevalent in America than elsewhere. The fact that relatively more people are in asylums for the insane than formerly is probably simply because a larger proportion of the insane are now cared for in asylums and the better methods keep them alive longer. The increase in deaths due to diseases of the brain is not so great as the increase in deaths from heart and kidney diseases. The relative increase of deaths from all these diseases is the corollary from the decrease in deaths from preventable causes—infection, filth, bad habits and the like.

The *a priori* argument that the conditions of modern life predispose to nervous disease is not very convincing to those familiar with the state of things in the past, when life, family and fortune were often in daily jeopardy. The energy and restlessness of the typical American may betray a lack of culture and refinement but it does not show physical degeneracy. The mean is dependent on the extremes and we find Americans the best athletes, whereas when we wish to see the most interesting cases of hysteric and nervous diseases we must go to Paris or Vienna. We might expect to find, and do find, in America good physical and mental traits, due to their origin from energetic emigrants and the admixture of races. As Dr. Knapp writes: "We should not then chatter glibly about the increased nervousness of our age, due to the greater demand which the conditions of modern life make upon the human brain. It is not a matter to be settled by a few phrases or by tables of very general and questionable statistics. We are by no means certain that there is any increased nervousness, and even if it do exist we do not know whether it is due to these greater demands or to injury or infection. It is also doubtful whether the conditions of modern life make as great demands upon the brain as did the conditions of life in the past. Finally, without more evidence in its favor, we must regard the belief in the greater nervousness of Americans as an error."

GENERAL.

WE venture to call attention in this place to the advertisment of the publishers on page iii., asking for back numbers of this JOURNAL. It is a matter for congratulation that more copies have been sold than had been expected by the publishers, and it is a matter of editorial interest that subscribers who wish to complete their sets for binding should be able to secure the lacking numbers.

THE death is reported, by cablegram, of Dr. August Kekulé, professor of chemistry in the University of Bonn.

WE have already called attention to the seventy-ninth meeting of the Swiss Society of Naturalists, which meets at Zurich from the 2d to the 5th of August. Lectures have been arranged for the general meetings as follows: Prof. Kölliker on the 'Arrangement of the Microscopic Elements in the Cortex of the Brain;' Prof. Bamburger on 'Chemical Energy;' Prof. Henri Dufour on the 'Study of Solar Radiation in Switzerland;' Prof. Shröter on the 'Flora of Lakes.' Special papers will be read before fifteen different sections.

THE Imperial University of Kasan (Russia) announces the Lobatchefsky prize of 500 roubles to be awarded every three years for works on Geometry, 'those on non-Euclidian to have the preference.' Works in competition must be sent in before October 22, 1896 (old style). The prize will be adjudged October 22, 1897.

THERE will be held during the month of September a meeting of Austrian chemists who have had an academic education, in order to consider the formation of a society for the consideration of subjects that concern technical chemistry.

IT has been proposed, according to *Nature*, that some token of esteem be presented to Prof. N. Story-Maskelyne in recognition of his distinguished services to mineralogical science, and to commemorate his long connection with

the University of Oxford. The presentation is intended to take the form, if possible, of a portrait, and it is believed that contributions not exceeding £2 in amount will be sufficient for the purpose. A number of men of science, both at home and on the continent, have already promised their support. Contributions will be received by Prof. A. H. Green, F, R. S., or Prof. H. A. Miers, F. R. S., University Museum, Oxford.

The New York *Evening Post* states that the well-known German anthropologist, Adolf Bastian, who has nearly reached his seventieth year, has gone on an exploration trip to the interior of China.

The arrangements made by the local committee for the Liverpool meeting of the British Association ensure much pleasure for those able to attend. University College, St. George's Hall and the Public Museum offer excellent and convenient rooms for the meetings, and there are many places of scientific interest in Liverpool and its neighborhood which will be included in the excursions. Longer excursions will be made at the close of the meeting to the Isle of Man, to the English Lakes and to the Vyrury Water Works in Wales. Receptions will be given by the local committee and by Lord Derby, the Lord Mayor of Liverpool. Parties will be entertained by Mr. Gladstone at Hawarden, by the Duke of Westminster at Eaton Hall and by the Earl of Derby at Knowsley. Liverpool is unusually convenient for American men of science, who are always entertained with courtesy.

The fiftieth anniversary number of the *Scientific American*, to be published this week, will be enlarged to about four times its usual size, and will contain, in addition to the prize essay 'On the progress of invention during the past fifty years,' a number of special articles and reviews of the progress of science and invention during the past fifty years; some of the principal subjects to be treated being the transatlantic steamship, naval and coast defense, railroads and bridges, the sewing machine, physics and chemistry, electrical engineering, progress of printing, the locomotive, iron and steel, phonograph, photography, telegraph, telephone, telescopes, the bicycle and the history of the *Scientific American*.

Sir Archibald Geikie, who, as we have already stated, will give before the Johns Hopkins University the first course of lectures under the George Huntington Williams Memorial, will begin the course in the latter part of April, 1897.

The Department of Natural Science Teaching of the National Educational Association elected the following officers: President, Chas. Skeele Palmer Boulder, Colorado; Vice-President, Albert H. Tuttle, Charlottesville, Va.; Secretary, Irwin Leviston, Omaha, Neb.

Mr. William A. Ingram, Secretary of the Board of Commissioners, has compiled a list of the publications of the Pennsylvania Geological Survey from 1874 to 1895, to which is added an index of the more important subjects treated in the volumes.

The British Medical Journal states that the exhibits in medicine and hygiene at the Berlin Industrial Exhibition are of special interest. As an example of these may be given the municipality building, which contains complete drainage ground plans of Berlin and the suburbs, plans and models of the pumping station, their machinery, etc., models of a warehouse and a dwelling house with complete drainage arrangements. A small fountain is fed by clear and innocuous water from the sewage farms, and near it are specimens of plants and cereals and vegetables grown on, and even otto of roses obtained from the sewage farms. Here too are the plans and drawings of the different Berlin water works; the pipe systems by which the houses are supplied; drawings, models and plans of municipal asylums and hospitals, of the municipal disinfecting institute, of the heating and ventilating apparatus in the municipal schools of the public bathing establishments, etc.

Mr. F. W. Edridge Green writes that it is proposed to form, in Great Britain, a society for the purpose of making researches in color blindness, instituting proper tests and preventing color-blind and defective-sighted men from acting in capacities in the marine and railway services for which they are physically unfitted.

He will be glad to hear from those who are interested in the subject and are willing to join the society. The subscription will be 5s. per annum.

Nature states that Mr. J. H. Maiden has been appointed Government Botantist and Director of the Botanic Gardens at Sydney, in succession to Mr. Charles Moore, who has recently retired, after a service, in these capacities, of nearly half a century.

ADVICES have been received from Tromsoe, Norway, that Arnold Pike's steamer, Victoria, has arrived there after having visited the aeronaut, Herr Andrée, at Dane's Island. The erection of a balloon house had been begun, and Herr Andrée expected to be ready to start on his voyage toward the north pole early in July. Before starting, however, it was the intention of the aeronaut to test his balloon thoroughly by sending it up attached by ropes and by telephone to the steamer Virgo, which vessel conveyed Herr Andrée and his companions and their outfit to Spitzbergen. On the way back from Spitzbergen the steamer Victoria called at Advent Bay on June 29th, where it was learned that the members of the Martin-Conway party and of the Swedish Geer-Knorring expedition were well. At that time Advent Bay was full of ice. Despatches from Irkutsk announce that M. Hansen, the Norwegian trader, left that town on June 1st for the north of Siberia. His journey is primarily for trading purposes, but he will also inquire into the truth of the recent rumors regarding Dr. Nansen, and see if the store of provisions left by Baron Toll in the New Siberian Islands for Dr. Nansen is still intact. M. Hansen's mission had been confided to him by the Russian Imperial Geographical Society.

AFTER having published some fifty volumes in the series of 'Classics for Children,' it is time that Ginn & Co. should include a scientific selection. They have done well in choosing Gilbert White's *Natural History of Selbourne* and in securing an introduction from Prof. E. S. Morse. It would not be possible to place a better book in the hands of a boy of fourteen. Observers of nature, such as White, Thoreau and Audubon, seem to be lacking at the present time. Biology has perhaps become so extended and complex that the amateur is discouraged, but, as has recently been suggested by correspondents of *Nature*, boys do not now take an interest in nature, and there is no large class from which naturalists may be supplied. The growth of cities, the preponderating interest in athletic sports, and the study of biology in the laboratory, have lead the schoolboy away from contact with nature. As Prof. Morse remarks, collecting still goes on, but stamps are a poor substitute for birds' eggs, butterflies, shells and the like. Under these conditions nothing could be more useful than a copy of *The Natural History of Selbourne* in every school and in every home.

A LARGE meteor is reported to have fallen in the small mining town of Santos Reis, Chihuahua, Mex. It made its descent at noon and was accompanied by a report louder than that made by a cannon. It struck the house of a miner and demolished the building, killing two children, and then buried itself in the ground to a great depth. The stone will be sent to the National Museum in the City of Mexico.

M. GABRIEL COLIN, formerly professor of physiology in the Veterinary School of Alfort, has died at the age of 71.

IN *The Journal of Mental Science* for July, Mr. John Turner gives some statistics dealing with hereditary insanity, based on 1,039 cases in the Essex County Asylum. It appears that daughters suffer most from insanity in the parents, but that insanity in the father is more likely to be hereditary. Thus 106 insane fathers had 117 sons and 138 daughters who were insane, and 236 insane mothers had 113 sons and 182 daughters who were insane. The statistics support Darwin's law of heredity, adult paternal characteristics being more liable to be transmitted to male offspring, and adult female characteristics to female offspring.

THE annual chart prepared by Mr. David T. Day, Chief of the Division of Mineral Resources, shows that the products of the United States for the year of 1895 were in nearly all cases in excess of those of the preceding year. The value of the products in 1894 was, however, less than in any year since 1887. The total

value of the metallic products in 1895 was $270,453,979 and of non-metallic products $340,-341,311. No tin was mined in 1895. The quantity of petroleum produced has remained nearly constant since 1892, but it appears that its value (?) has more than doubled.

The U. S. Geological Survey has just issued a number of important bulletins, of which we hope to give later some account. These bulletins are as follows: No. 123, A dictionary of geographic positions, Henry Gannett, pp. 183. No. 124, Revision of the American fossil cockroaches with descriptions of new forms, H. S. Scudder, pp. 176. No. 125, The constitution of the silicates, pp. 109. No. 126, A mineralogical lexicon of Franklin, Hampshire and Hampden Counties, Mass., B. K. Emerson, pp. 180. No. 128, The Bear River formation and its characteristic fauna, Charles A. White, pp. 108. No. 129, Earthquakes in California, Charles D. Perrine, pp. 23. No. 131, Report of progress of the division of hydrography for the calendar years 1893 and 1894, pp. 126. No. 132, The disseminated lead ores of southeastern Missouri, Arthur Winslow, pp. 30. No. 133, Contributions to the Cretaceous paleontology of the Pacific coast; The fauna of the Knoxville beds, T. W. Stanton, pp. 132. No. 134, The Cambrian rocks of Pennsylvania, Charles D. Walcott, pp, 46.

The Division of the Biological Survey of the Department of Agriculture has sent out a circular signed by Mr. T. S. Palmer, recommending that 'Bird Day' be observed in the schools. 'Arbor Day' has proved successful in arousing interest in the planting and preservation of trees, and it is urged that Bird Day would diffuse knowledge concerning our native birds and arouse a more general interest in bird protection. It is suggested that if it is deemed unwise to establish another holiday, or if it seem too much to devote one day in the year to a study of birds, the exercises of Bird Day might be combined with those of Arbor Day.

The experiments on the visibility of the Röntgen rays by Dr. Gustav Brandes, briefly noticed in this Journal, seem, according to the account in the *Sitzungsberichte der Berlin Akademie*, to have been carried out with much care and to demonstrate that the rays call up a definite sensation of light. Dr. Brandes thinks it probable that the rays do not immediately effect the retinal cells, but probably cause fluorescence of the pigment.

It is further reported from Berlin that Prof. Grunmach has been able to use the X-rays to determine calcifications resulting from pulmonary consumption. MM. Lortet and Genoud have reported to the Paris Academy that tuberculosis induced experimentally has been attenuated by exposure to the X-rays.

After a very complete and painstaking investigation of the morphological characteristics of a series of double sulfates containing potassium, rubidium and cesium, Alfred E. Tutton, of Oxford, reaches the conclusion that there is no chemical union between the molecular constituents of double salts, but that there is merely aggregation in accordance with such a particular type of homogeneous structure as ensures that the constituents are always present in the same proportion.

During the year 1895 there were published in France 10,115 new books, of which 153 were in philosophy; 473 in political and social sciences; 1,141 in medicine; 267 in geography and anthropology; 76 in mathematics and 251 in natural science.

Garden and Forest states that the United States Consul at Havre, France, recently sent home some samples of new textile fabrics which were exhibited at the State Department in Washington. They were woven from the fibres of peat, which, as they proved, can be bleached to whiteness and will then take any dye. These fabrics are said to be especially advantageous from the fact that they have antiseptic qualities which will prevent them from harboring disease germs.

The Hawaiian Congress recently passed an act by which every taxpayer in the island was compelled to register himself at the tax office, and, in addition to the usual entries according to the Bertillon system of identification, to leave in the registrar's book the imprint of his right thumb, in accordance with the recommendations of Mr. Francis Galton. The method of

identification was, however, regarded by many as an indignity fit only for criminals, and the law has been repealed.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Archæological Museum of the University of Pennsylvania has received a gift of $10,000 from Mr. B. N. Farren.

A FIRE occurred last week in the Boylston Chemical Laboratory of Harvard University. No series damage was done to the building, but as the fire occurred in the storage room through self combustion of chemicals its cause should be carefully investigated in order that similar accidents may be avoided.

THE nineteenth session of the Martha's Vineyard Summer Institute was opened on July 13th, with an attendance of nearly 800 teachers and other pupils.

AT a meeting of the executive committee of the board of trustees of Cornell University in Ithaca, on June 15th, the chair of the principles and practice of veterinary surgery, zootomy, obstetrics and jurisprudence in the New York State Veterinary College was filled by the election of Walter Williams, D. V. S., professor of veterinary science and physiology in the Montana College of Agriculture and Mechanic Arts, and veterinarian to the Montana Agricultural Experiment Station.

DR. V. BUCHKA, professor of chemistry at the University of Halle, has resigned to take a position in the Imperial Patent Office. Dr. Karl Müller has been appointed professor of botany in the Technical High School, Berlin. Dr. J. v. Gerlach, professor of anatomy in the University of Erlangen, and Dr. Carl Claus, professor of zoology in the University of Vienna, have retired.

IT is stated that the total number of students on the books of the 21 Italian universities in 1895–96 is 21,161, showing a slight increase as compared with the previous year. Adding to these the students, male and female, of the institutes of higher education, a total of 23,962 is reached. Of these 6,786 are students of medicine. The most frequented university is that of Naples, which has 4,956 students, Turin coming next with 2,434; then come Rome with 1,911, Padua with 1,664, Bologna with 1,375, Pavia with 1,345, Palermo with 1,343, Genoa with 1,089, Pisa with 1,066, Catania with 890, and Messina with 551. All the others have fewer than 500, those of Urbino and Ferrara having fewer than 100.

DISCUSSION AND CORRESPONDENCE.

AN INHERITED BLUNDER.

IT has been interesting to me for a number of years to notice how easily a blunder may be paraded and handed on from book to book in high honor, when a single careful thought would prove to any scientific person its absurdity.

The special case in mind is the conventional iceberg, as pictured in our school geographies and higher scientific texts. The first geography I ever saw had this physical monstrosity in it, and it is the common property of such texts up to date.

When we stop to think that an iceberg is merely a floating piece of ice, free to move in the mobile liquid water, we shall see at a glance that to be in stable equilibrium, the shortest dimension must be vertical. But notice the berg as shown in the conventional picture,

partly in diagram, as if seen through the water from the side. A berg as large as shown in some of these amusing cuts could not be kept in position by a whole fleet of great ships with grappling hooks and cables.

It is true that in some cases the artist has fitted blocks of stone into the ice near the bottom. But this has been done, very probably, to show the ice as an agent in transportation, and not in any case has he put ballast enough there to hold the berg down.

Here are some recent geography texts perpetuating this blunder. Appleton's Physical, p. 85, 1887; Butler's Physical, p. 79, 1887;

Frye's Complete, p. 9, 1895; Potter's Advanced, p. 12, 1891; Monteith's New Physical, p. 78, and Tarr's Physical, p. 316, 1896. In the last case it has ceased being a picture and has become wholly a diagram. But Prof. Tarr could tell a better fact and save two square inches of space by drawing a proper 'diagram.'

But the school texts have no monopoly on this comical berg. In the 'Story of Our Planet,' by T. G. Bonney, 1893, there are three of them, not so unstable as the others, but still ready to 'flop.' And in 'Man and the Glacial Period,' by G. Frederick Wright, p. 18, 1892, and by the same author, the more pretentious work, 'The Ice Age in North America,' 1889, p. 107, this physical impossibility is held in high esteem. In the latter work the author is not content to leave it in the text, but it glares at you in gilt from the back of the book, every time you pass it in its place on the shelf.

It is truly a relief after looking through this list to pick up A. Geikie's Text-book of Geology, and J. Geikie's 'Great Ice Age,' and find real rational icebergs.

J. Paul Goode.

SCIENTIFIC LITERATURE.

The Royal Natural History: Mammals. By Richard Lydekker. London and New York, Frederick Warne & Co. New York. 1893–95.

The mammal part of Lydekker's Royal Natural History is now completed, and most of the bird parts are out also.

The attempt of the author and publisher to produce a popular 'Natural History,' entertaining to the general reader and at the same time scientifically accurate, has met with more than the usual measure of success. The work is handsomely gotten up and profusely illustrated.

It was hoped that some of the errors and omissions of the original edition would be corrected in the American reprint, but no changes whatever have been made. In fact, there is in reality only one edition for both issues are printed from the same type and on the same paper. The only difference is in the outside covers, which in the American issue bear later dates. This should be borne in mind in quoting the work, as it is important to give the correct date. The last part came out in England before the middle of last year (1895).

The mammal part covers about 1,500 pages, royal octavo size, and, in spite of numerous inaccuracies, affords the naturalist, student and sportsman the best and most reliable general account yet published of the highest class of the animal kingdom. Since the English edition was reviewed at some length in this journal (Science, April 5, 1895, pp. 387–389, and July 5, 1895, pp. 18–21) it is unnecessary to say anything further about the American issue. If the publishers would get out an American supplement, bringing the matter down to date from the American standpoint, the work would long remain a standard of reference on the Mammalia.

C. H. M.

THE PALPI OF BUTTERFLIES.

Ueber die Palpen der Rhopaloceren. Ein Beitrag zur Erkenntnis des verwandtschaftlichen Beziehungen unter der Tagfaltern. Von Enzio Reuter. Acta Soc. Scient. Fennicæ. T. xxii. No. 1. Helsingfors, 1896, 4°.

In this work, one of the most important recent contributions to our knowledge of the structure and classification of butterflies, the author expands fully the discovery announced by him a few years ago of an area of peculiar character on the inner side of the basal joint of the palpi of these insects, varying greatly in extent and nature in different groups and affording, as he believes, perhaps too confidently, an important test of relationship. That he has not reached his conclusions on any cursory study or meagre material will be evident from this volume of nearly six hundred pages, its accompanying plates, and the statement that he has examined 3,557 palpi of 670 species belonging to 302 genera, appertaining to all the principal groups except the Hesperidæ, which he neglects.

The structure and clothing of the palpi are given in detail for each genus, with a specification of the species examined and the number of individuals of each. The characteristics of the scaleless region called the *basalfleck* are a rippled, pitted surface, covered with conical dermal appendages, and the variations in their extent and character are brought out by this study, which

occupies the first part of the work, entitled *Untersuchungen*. The second and larger part, termed *Schlussfolgerungen*, is devoted to an application of this study to the classification of butterflies, group by group in great detail, in which is included a consideration of other parts of the structure and notably of the neuration of the wings in the perfect insect, but very little of the early stages, even where, as not infrequently, these would have given support to the special position maintained.

Reuter separates the Hesperidæ as a distinct suborder from the other butterflies, which last he divides into six gentes, in ascending order as follows: Papiliones (with the families Papilionidæ and Pieridídæ), Lycaenæ (with the families Lycaenidæ and Erycinidæ), Libytheæ, Danaidæ, Satyri and Nymphales (each with a single family). His subfamilies are eighteen in number, his next subdivision called stirpes scarcely more numerous, while the tribes number sixty. A genealogical tree, far more detailed than any yet attempted, explains pictorially his views of the phylogeny of the group, that is, the precise origin and partings of each of these gentes, families, subfamilies, stirpes, tribes, and even in a few cases groups of genera. The union of the Grypocera (Hesperidæ) and Rhopalocera is not shown, but the six gentes are all made to diverge simultaneously from the rhopaloceran trunk. It is a scholarly investigation and we commend it heartily to all naturalists.

A Dictionary of the Names of Minerals including their History and Etymology. By ALBERT HUNTINGTON CHESTER, E. M., Ph. D., Sc. D. New York, John Wiley & Sons.

It is significant of an implanted tendency towards system, or else it is the evidence of an essentially vital relation to external nature, that men crave names for objects. The child ministering to its first curiosities, as it meets new things asks for a name, and afterwards for an explanation of the creature or machine or specimen which it sees. The amateur collector feels a new sense of possession when he labels his miscellaneous cabinet of rocks and minerals and shells, and the delight with which he welcomes an addition to his stock of treasures takes on a keener sense when he can give a name to the late arrivals. A name circumscribes and delineates an object, and makes it more self-existent, as it were, feeding in us the premonition of a further inquiry as to its exact nature. To apply a speculation developed in Prof. Lloyd Morgan's 'Comparative Psychology,' names render objects 'focal' in consciousness, rather than 'marginal' and bring the roving eye of observation intently upon their outlines and characteristics.

The history of the nomenclature of science is full of entertainment and instruction; it is its structural history, the story of its growth, for it reflects in every stage of its development, the changing and widening knowledge, which, like an increasing stream, spreads with curving accessions over broader and broader tracts, and leaves, in names, the beach lines of its various extensions and deflections.

Names in mineralogy might be collectively grouped into four periods, that of the ancients from Theophrastus to Pliny, that of mediæval charlatanism and the alchemists, from Marbodeus to Albertus Magnus and Robert Boyle, the formative period from Steno to Werner, Haüy, Brewster, Romé de Lisle, etc., until 1820 or 1840, and the modern period. To trace the analogues, replacements, dislocations and corrections of names over this long stretch of years, intermitttently marked by activity in separate centers or individuals, until we reach the zonal glow of enthusiasm in mineralogy as a science, with the erection of a rational chemical philosophy, would form a treatise of great value. Prof. Chester possessed of great erudition in the archæology of mineral terminology, and ardent in his devotion to a science in which he has won distinction, might be fitly selected for such an exhaustive research. The present work over his name might be regarded as a preliminary contribution to such a study. This work encloses between its covers four thousand six hundred and twenty-seven names, arranged in alphabetical order, with usually a brief paragraph of explanation assigned to each, except where a name is a misprint, variant or synonym.

Prof. Chester has accomplished in the preparation of this dictionary a very useful work, and has undertaken a great amount of discrim-

marine beds of the Trias. Such are known in the Alps, Himalayas, Salt Range of India, Siberia and western North America. Quite recently the Vienna geologists, Drs. Mojsisovics, Waagen and Diener have proposed a classification of the Marine Trias. Four series are recognized, the Scythic, Dinaric, Tirolic and Bajuvaric. These are divided into stages, substages and zones. In the present paper the author attempts to show the relations of American marine strata to those of Europe and Asia on the basis of the above classification. He concludes that the Alps cannot longer be said to furnish the typical region even for marine Trias, but that each region of the earth has some open sea development of a stage lacking elsewhere. Hence studies in faunal geography must be combined with those in phylogeny.

The Geology of the Little Rocky Mountains: By WALTER HARVEY WEED and LOUIS V. PIRSSON. The Little Rocky Mountains of northern Montana are far removed from the Rocky Mt. Cordillera. They are formed by a dome-shaped uplift exposing Archean and Paleozoic rocks in a region of horizontal Cretaceous strata. They represent on a smaller scale the kind of phenomena we have in the Black Hills uplift as described by Russel in a former number of the *Journal*. The nucleal core is of crystalline schists, but the structure has been modified by the intrusion of a great laccolitic mass of granite porphyry. The schists are thought by the authors to be Archean. Above these are shown beds of Cambrian, Silurian, Devonian, Jurassic and Cretaceous. Petrographic study of the prophyry shows it to belong to the alkali granite-syenite series. It is very poor in lime magnesia and iron. The magmas resemble those of the other detached mountain groups of Montana. Ores bearing both gold and silver are found associated with flourite in the altered porphyry. The occurrence of telluride ores is much the same as at Cripple Creek. In most of the ores free gold is found in spongy masses of dark copper color. The Goldbug mine is the only property which shows much development, and this is being prospected now.

Schistosity and Slaty Cleavage: By GEORGE F. BECKER. The idea developed in the paper is that the deformation of a solid, homogeneous, viscous, isotropic, not infinitely brittle mass will develop structures in it on not less than one surface, nor on more than four surfaces simultaneously. These structure surfaces will in general stand at acute angles to the direction of the pressure to which they are due, and the flattening of the strain ellipsoids will not be normal to the pressure save in a limiting case. The common theory of slaty cleavage is well known.

The author presents evidence that solid flow does produce cleavage which is parallel to the lines of relative tangential motion or gliding and that this need not be accompanied by rupture, however microscopic. He thinks that no closer approach to slaty cleavage can be gotten by flattening of the particles even in a weak matrix than is gotten in natural sandstones, for in these there is approximate parallelism of the grains of quartz and mica scales with the bedding.

Deformation of Rocks, III.: By C. R. VAN HISE. In this paper schistosity and cleavage are discussed mainly. After defining the terms and referring to the literature of the subject the author lays down and supports the following propositions. (1) Rock cleavage is due to the arrangement of mineral particles with their long axes or readiest cleavage in a common direction and that this is caused by parallel development of new minerals, by flattening and parallel rotation of old and new mineral particles and by flattening and parallel rotation of random original particles. (2) The secondary structure of a rock deformed by plastic flow develops in the plane normal to the greatest pressure and is true cleavage. (3) In heterogeneous rocks having cleavage, in a soft layer the cleavage more nearly accords with bedding than it does in a hard layer. (4) Upon opposite sides of an anticline cleavage usually diverges downward, while on opposite sides of a syncline it usually converges downward. (5) In regions of overturned monoclinal folds the cleavage may be rotated in the same direction throughout, and hence be monoclinal. (6) Fissility developed in the shearing planes is usually secondary to cleavage developed in the normal planes.

inating toil. That 'dead work' which Prof. Leslie so vigorously declared was one of the most essential tasks of the laborers in Science's behalf is here prominently shown. Names which are erroneous in spelling or obsolete, or synonomous, or applied doubtfully, or misapplied, are here recorded, and the student, the lay-reader, the collector, and man of science, can at once determine the status and significance of mineralogical names as currently used. Prof. Chester, in his preface, says: "In this work the endeavor is made to give complete information, as outlined above, concerning all the names that have ever been introduced into the nomenclature of mineralogy. Nearly all published works on this subject have been searched to prepare a complete list of such names, and all available sources of information have been consulted. Many facts have been received in private communications from correspondents at home and abroad, a list of whose names is appended. But a number of blanks still remain, after years of research, and the author greatly desires information on any of the points lacking."

The author gives some general and particular notes on names, as to the attempt of Moh and Dana to introduce binomial methods, and reveals the great difficulty, in some instances, in determining the real origin of a designation. He illustrates this in the case of the well-known mineral *Datolite*. It appeared very early under the spelling *datholite*, which was a corruption of the original name *datolith* of Esmark, from δατέομαι, to divide, in reference to its granular structure, and λιθος, a stone. Werner inserted the h, and this led to its erroneous interpretation as coming from δαθος or turbid, which was succeeded by the criticism that there was no such Greek word, and its origin is from δα-θολλος, meaning very turbid, because it is never found in transparent crystals. The correct derivation was detected by Prof. Dana in 1868. Many other instances give a forcible impression of the care and learning required for a correct diagnosis of the elements of a mineralogical name.

The work is compendious and very useful, but it seems regrettable that Prof. Chester had not written a more extended treatise, by way of introduction, reviewing the stages of change which have finally given us the present series of names. The expressed regret that all mineral names should end in *ite* does not seem warranted. Haüy's names, in so many instances, pleasingly vary, to the ear, this monotonous termination, that we wish there were more judicious exceptions to its almost universal predominance. No mineralogist should be without this dictionary, and to a large public, outside of this specific designation, it will be valuable as a guide to the derivation, proper orthography and meaning of mineralogical names. Its typography seems faultless.

L. P. Gratacap.

Laboratory Experiments in General Chemistry. By Charles R. Sanger. St. Louis, 1896. Published by the Author. Pp. 59.

Experiments in General Chemistry and Notes on Qualitative Analysis. By Charles R. Sanger. St. Louis, 1896. Published by the Author. Pp. 49.

The first of these pamphlets contains directions for 108 laboratory experiments upon the preparation and properties of the elements and compounds. They have been arranged for the use of students who are taking a course of lectures upon descriptive chemistry. The experiments are all well known ones, and the order of management is the one already adopted in laboratory manuals.

The second pamphlet contains directions for 39 of the experiments given in the first pamphlet, and in addition has 28 pages devoted to a description of the methods used in making qualitative analysis of unknown substances. This course has been arranged for medical students. Neither of these laboratory guides differ in any essential feature from the well known laboratory manuals on elementary chemistry and qualitative analysis. E. H. K.

SCIENTIFIC JOURNALS.

JOURNAL OF GEOLOGY, MAY–JUNE, 1896.

Classification of the Marine Trias: By James Perrin Smith. As might be expected the names given to the Triassic beds of the Germanic basin, which was shut off from the open sea, have proved to be of little use as applied to